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Sports and Exercise for People with Diabetes

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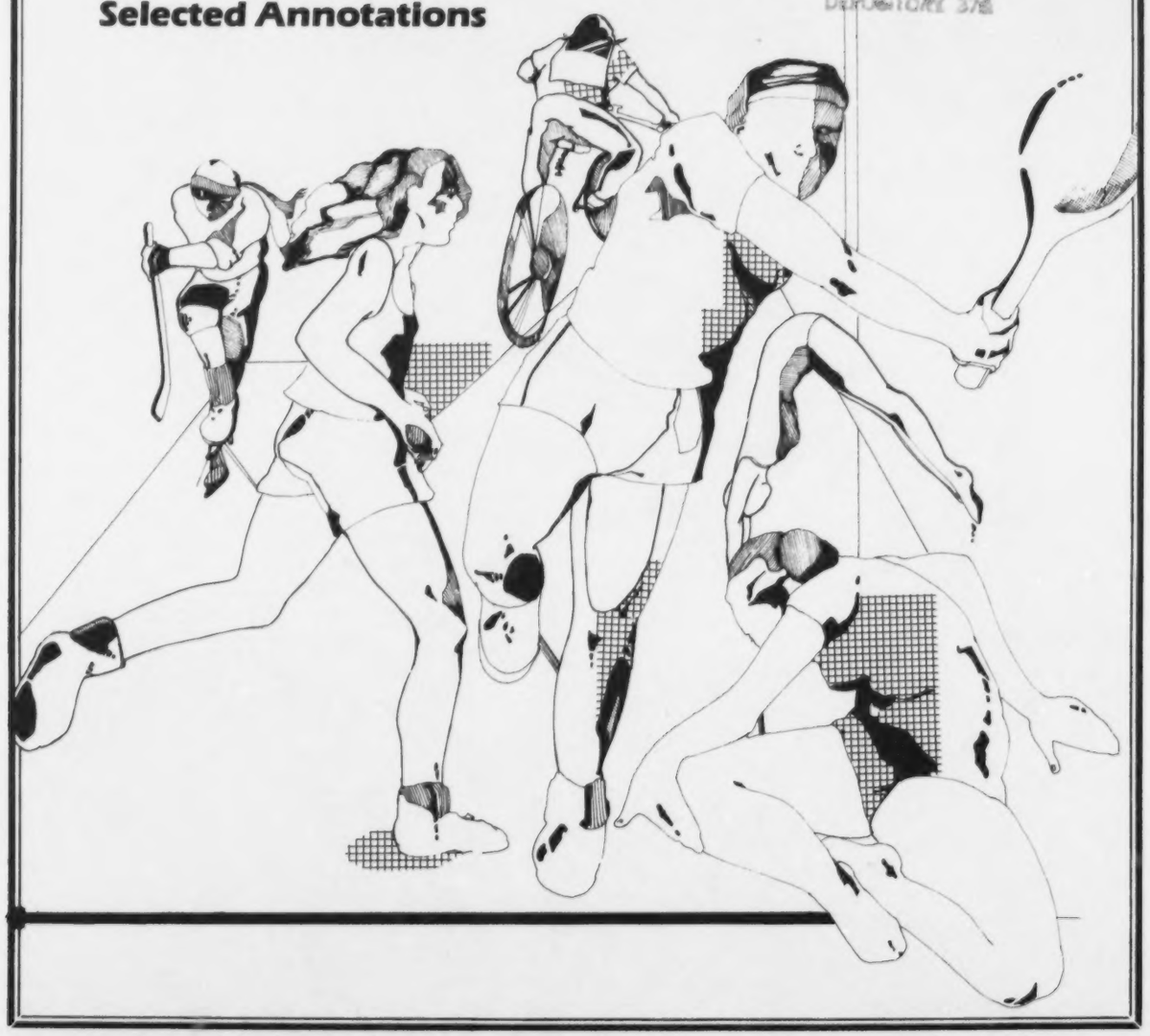
Selected Annotations



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
National Institutes of Health

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Sports and Exercise for People with Diabetes

Selected Annotations

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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SPORTS AND EXERCISE FOR PEOPLE WITH DIABETES

SELECTED ANNOTATIONS

PREFACE

The staff of the National Diabetes Information Clearinghouse has prepared this bibliography as an information resource for those concerned with the role of sports and exercise in the lives of people with diabetes. Materials described include print and nonprint items in two categories: public and patient resources, and professional resources. Items in the first category have been selected for their potential usefulness to persons with diabetes, their families, and the general public. The second category, emphasizing resources that are more technical, is intended primarily for health care providers, health educators, and others assisting those with diabetes.

No attempt has been made to assess the educational value of the items listed, and their inclusion does not imply endorsement by the National Institute of Arthritis, Metabolism, and Digestive Diseases. If an item has been evaluated by an organization, that information is included. The bibliography represents a selection of materials available on the subject of diabetes and exercise and is not intended to be exhaustive.

Since the Clearinghouse does not distribute materials, please contact the source indicated. Journal articles may be located with the assistance of a local library or a medical library. Please send any comments or inquiries and also additional materials on the subject to the following address:

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EXPLANATORY NOTES

1. The format for bibliographic citations generally follows National Library of Medicine bibliographic practices or those of American National Standard for Bibliographic References.

2. Unsigned abstracts have been prepared by NDIC staff. Sources of other abstracts are indicated by the following abbreviations:

AA	Author abstract
UM	University of Michigan, Learning Resource Center and Diabetes Research and Training Center, Audiovisual Resources for Diabetes Education. 2d ed. Ann Arbor: The University, 1980.
-M	Abstract modified by Clearinghouse staff

3. Abbreviations Used in Citations:

[anon.]:	Author unknown
b&w:	Black and white
[n.d.]:	Date unknown
sd:	Sound

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SPORTS AND EXERCISE FOR PEOPLE WITH DIABETES

SELECTED ANNOTATIONS

PUBLIC AND PATIENT RESOURCES

Print Materials

1. Buerger-Allen Exercises. [anon.]. Toronto: Canadian Diabetes Association; [n.d.]. 1 p.

The sheet illustrates foot exercises designed to improve the blood circulation. They are to be performed daily before rising.

Price: Free.

Source: Canadian Diabetes Association; 123 Edward Street, Suite 601; Toronto, Ontario M5G 1F2, Canada.

2. The Diabetic's Sports and Exercise Book: How to Play Your Way to Better Health. J. Biermann; B. Toohey. New York: J.B. Lippincott; 1977. 256 p.

The book focuses on the contribution exercise and sports can make in the daily control of diabetes. Topics include reading body signs, coping with insulin reactions, testing blood sugar, avoiding and treating sports injuries, exercise programs for all ages, calorie expenditure, and high sugar snacks. Specific information parents, teachers, coaches, and counselors should know about the nature of diabetes and the relation between diabetes and exercise is also given. Personal experiences of athletes with diabetes are recounted.

Price: $5.95/paperback.

Source: June Biermann and Barbara Toohey; Sugarfree Center for Diabetics; 5623 Matilija Avenue; Van Nuys, CA 91401. (213) 780-1308.

3. Diabetes and Exercise. [anon.]. Milwaukee: Family Hospital; [n.d.]. 6 p.

Six reasons for exercising related to control of diabetes are presented in this leaflet. A physical examination, gradual buildup in activity, a regular schedule, exercise 2 hours after meals, and the precaution of carrying candy at all times are recommended. Crash

programs, exercise for uncontrolled or overweight persons with diabetes, and poor timing relative to meals are not recommended. Exercise tips cover warmup and cooling down periods, symptoms of trouble, and environmental factors.

Price: Free.

Source: Diabetic Coordinator; Family Hospital; West Wells at North 28th Street; Milwaukee, WI 53208. (414) 344-9400.

4. Diabetic Athlete. Council on Scientific Affairs. Chicago: American Medical Association; 1980. 15 p.

Preparation for an athletic regimen is discussed in this booklet. The Council recommends that a young person with insulin-dependent diabetes should have a physical examination and assessments of urine, glucose, and hemoglobin Alc test results before intitiating an athletic regimen. Careful attention should be given to planning a diet, exercise program, and timing and location of injections to prevent hypoglycemic reactions during exercise.

Price: $1.50. Order No.: OP-084.

Source: Order Department OP-084; American Medical Association; P.O. Box 821; Monroe, WI 53566. (312) 751-6000.

5. Diet and Exercise. [anon.]. Boston: Joslin Diabetes Foundation; 1976. 12 p.

Exercise and diet are discussed with respect to their influence on the amount of insulin needed by the body. Exchange lists and sample menu plans are provided.

Price: $0.35.

Source: Joslin Diabetes Foundation, Inc.; Joslin Clinic; 1 Joslin Place; Boston, MA 02215. (617) 732-2539.

6. Easy Weight Control with Diet and Exercise. J. Lane; M.E. Rosenlund. Cleveland: Diabetes Association of Greater Cleveland; [n.d.]. 104 p.

A 31-day diet and exercise plan is described. General information is given on desirable weights and preparation for the program. Each exercise is illustrated and step-by-step procedures are listed. A table of energy expenditures for daily activities and sports is included.

Price: $3.00.

Source: Diabetes Association of Greater Cleveland; 2022 Lee Road; Cleveland, OH 44118. (216) 371-3301.

7. Exercise and Diabetic Control. B. Zinman. Beta Release. 3(1):1-2; March 1978.

The article emphasizes the importance in diabetes management of understanding the mechanism of exercise-induced hypoglycemia and its relation to the insulin injection site. Plasma glucose decreases in the person with diabetes about 15 minutes after the onset of exercise. The use of injection sites near active muscles affects blood sugar levels during exercise since muscular activity appears to enhance insulin absorption.

8. Exercise, Diets and Insulin for Children with Diabetes. D.W. Guthrie. Nursing (Jenkintown). 7(2):48-54; February 1977.

Information for nurses who instruct children with newly diagnosed diabetes and their parents covers the initial hospitalization. Topics discussed include parental acceptance of diabetes and involvement in the child's therapy, urine testing, insulin injection, diet, and physical activity. Emphasis is placed on the need for parents to be flexible and supportive as the child learns to manage the condition. Parents are taught to consider variables such as emotional stress, illness, and unusual levels of physical activity when control is poor and to know when to consult the physician.

9. Exercise Prescription for Diabetics. M.W. Manley. The Diabetes Educator. 3(2):23-24; Summer 1977.

A chart of calorie expenditures for various exercises is included in this discussion of educating the newly-diagnosed patient with diabetes who is hospitalized for metabolic regulation. The exercises are performed in the hospital's physical therapy department. Once equipment has been explained, most patients are able to use the department without supervision.

10. Fitness First: A 14-Day Diet and Exercise Program. J. Jones; K. Kientzler. San Francisco: 101 Productions; 1980. 154 p.

This 2-week diet and exercise regimen is based on the diabetic exchange list and personalized exercises. In the diet program, caloric intake is balanced with energy output to control weight. Charts contain food portion data (calories, carbohydrates, proteins, and fats), food portion sizes, and weekly diets. A number of recipes are included, most of them without additive sugar. Recommended elements of the personalized exercise program are stretching, breathing, relaxation, and more strenuous activities. A bibliography and a recipe index are included.

Price: $6.95.

Source: Charles Scribners Sons; Vreeland Avenue; Totowa, NJ 07512. (312) 486-2878.

11. On the Slopes. B. Toohey; J. Biermann. Diabetes Forecast. 30(6): 14-17; November-December 1977.

Skiing provides relative freedom from dietary restrictions and decreased insulin requirements for persons with insulin-dependent diabetes. Precautions to be taken include carrying emergency identification and an adequate supply of food at all times. Preplanning includes the adjustment of insulin injection sites, increased caloric intake, and contact with the ski patrol before skiing.

12. Recreation for Disabled Persons. E. Ogg. New York: Public Affairs Pamphlets; 1979. 28 p. (Public Affairs Pamphlet No. 571).

The pamphlet identifies resources for involvement in sports and the arts for persons with various disabilities. The benefits of physical activities and other types of recreation are described, as are the problems of architectural, transportation, and attitude barriers. A list of associations providing information is included.

Price: $0.50 each/1-9; $0.35 each/10-99; Write for rates of larger quantities. Order No.: 571.

Source: Public Affairs Pamphlets; 381 Park Avenue, South; New York, NY 10016. (212) 683-4331.

13. Sports and Diabetes. L. Levine. Hackensack: New Jersey Affiliate; 1978. 6 p.

This brochure is a transcript of one of 22 "Diabetes Tapes by Phone for Patients." The point is made that sports and diabetes are not incompatible. A four-part analysis of the prospective athlete with diabetes focuses on control of the disease, the person's interest in athletics, athletic ability, and knowledge of the risks. A warning about hypoglycemia is included.

Price: $0.10; $0.09/1000 or more.

Source: American Diabetes Association, New Jersey Affiliate, Inc.; 345 Union Street; Hackensack, NJ 07601. (201) 487-7228.

14. Ten Steps to a Successful Exercise Program. T.M. Flood. Medical Times. 108(5):69-76; May 1980.

Steps to guide physicians' involvement in the exercise program of patients with diabetes are outlined. It is suggested that physicians keep detailed patient records and that they consider patients' overall status, proper muscle conditioning, the adequacy of diabetes management, regularity in exercise, the prevention of hypoglycemia, and diet and insulin dose revisions if needed.

15. Time Out for Foot Care. [anon.]. Minneapolis: Metropolitan Medical Center; 1977. 4 p.

This is an illustrated outline of the Buerger-Allen exercises designed to increase foot comfort and improve blood flow to and from the feet. Eight guidelines to good foot care are also given.

Price: $0.25; $2.50/12.

Source: Diabetes Education; Metropolitan Medical Center; 900 South Eighth Street; Minneapolis, MN 55404. (612) 347-4654.

16. 26 Miles to the Finish Line. P. Harper. Diabetes Forecast. 32(2): 26-32; March-April, 1979.

A marathon runner with diabetes describes the effects of her running experience: improved self-esteem, increased energy, and better diabetes control with less insulin. Training for races and the competition itself require careful adjustments in balancing insulin dosage, diet, and exercise.

17. What's New in Exercise? P.W. Felts; W.F. Marshall. Diabetes Forecast. 32(2):16-17, 38; March-April 1979.

This summary of the 1978 Kroc Foundation conference on diabetes and exercise (see Item 30) focuses on the physiological effects of exercise and the need to control the glucose-insulin balance. Conference participants discussed exercise-caused variations in mobilized glucose, insulin, hormones, and fatty acids. They noted that exercise enhances insulin absorption because of increased blood flow, increased permeability of capillaries, and the massaging effect of muscles on tissues at the injection site. To avoid hypoglycemia, calories must be increased or insulin decreased. Problems in developing an individualized exercise program were also discussed.

18. Who's Running? T.M. Flood. Diabetes Forecast. 32(2):20-25; March-April 1979.

Runners with insulin-dependent diabetes were surveyed to assess the effects of their running activities on diabetes control. Of the 100 subjects, 50 said regular running decreased their insulin requirement. Although some felt diabetes was a handicap, no one reported serious insulin or hypoglycemic reactions, and foot problems were those typical of runners in general. About half competed in races, with 10 percent in marathons. Advice from individual runners with diabetes is given, and safety precautions for running are noted.

19. Your Questions Answered. P. Powers. Diabetes Forecast. 32(2): 36-37; March-April 1979.

Questions on jogging and running are answered by a physician who has diabetes and is a marathon runner. Subjects include exercise during training, benefits of time spent running in relation to distance covered, and adjustments in carbohydrate intake and insulin dose to prepare for training and marathon races. It is recommended that the practice of carbohydrate depletion followed by carbohydrate loading prior to a race be modified in the case of a runner with diabetes.

SPORTS AND EXERCISE FOR PEOPLE WITH DIABETES

PUBLIC AND PATIENT RESOURCES

Nonprint Materials

20. Exercise and Diabetes [Videorecording]. Minneapolis: Metropolitan Medical Center; 1979. 1 cassette; 9 min.

This cassette is number 3 in a series of 18. Reasons why exercise and good eating habits are the cornerstones of diabetes control are presented. Nine benefits of exercise are listed. The program also stresses the necessity of eating before exercising and the value of a 5-minute warmup.

Price: $150.00.

Source: Diabetes Education; Metropolitan Medical Center; 900 South Eighth Street; Minneapolis, MN 55404. (612) 347-4444.

21. Exercise for the Diabetic: An Essential Tool for Good Control [Videorecording]. Columbia, SC: Division of Chronic Disease Control; 1979. 1 cassette; 90 min.

General principles of exercise are described, as well as special considerations for each type of diabetes. The program identifies hypoglycemic reactions that can occur during exercise and therapeutic techniques for controlling them. The benefits of exercise to the person with diabetes are emphasized. A question and answer session ends the program.

Price: Loan: free.

Source: Division of Chronic Disease Control; South Carolina Department of Health and Environmental Control; 2600 Bull Street; Columbia, SC 29201. (803) 758-4763.

22. My Friend EDI [Videorecording]. Baltimore: Milner-Fenwick; 1971. 1 cassette; 15 min.; sd.; col.; 3/4 in.

The film presents a dramatization of a child with recently diagnosed diabetes and his mother, both exhibiting the initial fears, misconceptions, and general confusion associated with the disease. Meal planning and administration of insulin shots are concerns expressed by the mother; the child is frustrated by the restrictions the disease will impose on sports and exercise. The appearance of an animated character named EDI (exercise, diet, and insulin) alleviates

these concerns. EDI explains the causes of the disease, the appearance of sugar in the urine, the function of insulin, the formation and appearance of ketones in the urine, and the importance of maintaining a balance between exercise, diet, and insulin. Once the child has been informed, EDI allays the mother's fears regarding exercise limitations. (UM-M)

Price: Loan: $15.00/month; Sale: $295.00.

Source: Milner-Fenwick, Inc.; Education Division; 3800 Liberty Heights Avenue; Baltimore, MD 21215. (800) 638-8652.

SPORTS AND EXERCISE FOR PEOPLE WITH DIABETES

PROFESSIONAL RESOURCES

Print Materials

23. Catecholamines and Exercise. N.J. Christensen; H. Galbo; et al. Diabetes [suppl. 1]. 28:58-62; January 1979.

Factors affecting the response of catecholamines to exercise in patients with diabetes are examined. Catecholamines are produced to increase heart rate and oxygen supply during exercise, in accordance with sympathetic nervous system activity and blood glucose concentration. Insulin-dependent persons are affected by insulin mobilization which decreases glucose production and may cause hyperglycemia. It is believed that elevated catecholamine levels during exercise in untreated diabetes and lowered levels in long-term diabetes most likely correlate with autonomic neuropathy. Further study is recommended on this possible correlation. (See also Item 30.)

24. The Control of Fuel Utilization by Muscle During Exercise and Starvation. E.A. Newsholme. Diabetes [suppl. 1]. 28:1-7; January 1979.

Fatty acid mobilization and glucose utilization by muscles during exercise are considered. Three issues in energy utilization control are relevant: the rate at which fuel oxidation in muscles is regulated to energy requirements of the contractile system; the rate at which stored body fuel utilization is regulated to muscle utilization rates; and the way in which glucose and alternative fuel utilization by exercising muscles is integrated with fuel availability and fuel requirements of other tissues. It is concluded that the rate of muscle glycolysis and hepatic glycogenolysis is highly sensitive to glucose levels and that the transition to fatty acid oxidation to maintain glucose levels is essential in sustained exercise. (See also Item 30.)

25. Diabetes and Exercise. B. Zinman. Postgraduate Medicine. 66(5): 81-82; November 1979.

The central role of insulin in mediating muscle energy requirements during exercise is addressed. In severe insulin deficiency states, glucose uptake by exercising muscles is impaired and plasma glucose is increased. With excess insulin, inhibited hepatic glucose production, and exercise-decreased plasma glucose, symptomatic hypoglycemia can result. Extra carbohydrate prior to exercise, rather than a decreased insulin dose or an altered injection site, is recommended for persons who develop hypoglycemia during or after exercise, since exercise activities cannot always be predicted when insulin is administered.

26. Diabetes and Exercise: Clinical Implications. J.S. Skyler. Diabetes Care. 2(3):307-311; May-June 1979.

Exercise studies of clinical significance in diabetes control are noted. The balance of energy use, energy availability, and insulin action which enables energy to be used is essential in successful diabetes treatment. Energy is supplied by free fatty acids during rest and moderate or prolonged activity and by glucose during acute exercise. Physical training may decrease insulin levels, thus aggravating hypoglycemia, or may cause hyperinsulinemia due to the mobilization of insulin from subcutaneous injection sites. Cardiovascular and nervous system complications of diabetes should be considered in an exercise program, and food should be provided before or during physical activity to avert hypoglycemia.

27. The Diabetic in Physical Education, Recreation, and Athletics. D. Engerbretson. Journal of Physical Education and Recreation. 48(3): 18-21; March 1977.

The importance of physical exercise in diabetes management is stressed. Regular exercise appears to be as important as diet and insulin in the control of diabetes. Persons with well controlled diabetes should be encouraged to participate fully in physical activities. (AA-M)

28. Diminished Insulin Response in Highly Trained Athletes. D. Lohmann; F. Liebhold; et al. Metabolism. 27(5):521-524; May 1978.

Insulin secretion and glucose tolerance were examined in 6 highly conditioned athletes in comparison with a control group of 115 normal healthy persons. During glucose infusion, the athletes showed low insulin secretion, although there was no difference in the levels of blood glucose compared to the control group. It is concluded that under physiologic conditions the extent of insulin secretion is not dependent only upon the blood glucose levels. The results show that a lack of insulin response can occur as a consequence of adaptation to physical training. A reduced insulin response, therefore, does not necessarily indicate a diabetic or prediabetic state. (AA)

29. The Effect of Physical Training on Glucose Tolerance and Plasma Lipids in Maturity-Onset Diabetes. N.B. Ruderman; O.P. Ganda; K. Johansen. Diabetes [suppl. 1]. 28:89-92; January 1979.

The role of physical training in diabetes therapy was studied. Exercise on a bicycle ergometer lasted 3-6 months and involved six noninsulin-dependent, middle-aged men treated with diet only. Glucose tolerance was measured, and triglyceride and cholesterol levels were determined. In all cases, diabetes was associated with fasting

hyperglycemia, inability to dispose of exogenous glucose, and deficient insulin secretion. Triglyceride levels were decreased, but the effect of exercise on cholesterol was less clear. (See also Item 30.)

30. Exercise and Diabetes: An Overview. M. Vranic; S. Horvath; J. Warren. Diabetes [suppl. 1]. 28:107-110; January 1979

This review summarizes presentations at the Conference on Diabetes and Exercise held in Santa Ynez, California, in March 1978. The overall purpose of the conference was to review research in the role of exercise in diabetes and evaluate what is now known about the effects and influences of exercise on diabetic patients. Attention was directed to blood flow and oxygen uptake adaptation, energy regulation, and metabolic interactions in isolated tissues during exercise. Participants generally agreed that exercise should be adjusted to the individual's general health and that exercise may have adverse metabolic effects in patients with ketotic diabetes and marked insulin deficiency. The discussions indicated a need for investigations, including interdisciplinary studies, on a wide spectrum of diabetic states. Extensive biomedical references are included in conference presentations. (Note: this supplement of Diabetes consists entirely of the proceedings of this conference.)

31. Exercise and Diabetes Mellitus. M. Vranic; M. Berger. Diabetes. 28:147-67; February 1979.

The article reviews the effect of exercise on glucose metabolism, interactions between exercise and insulin, and benefits and hazards of exercise in persons with diabetes. Exercise can accelerate the mobilization of insulin from subcutaneous depots to the point that hyperinsulinemia may inhibit glucose production while glucose utilization continues at a normal rate. On the other hand, exercise can result in hypoglycemia when insulin deficiency causes inadequate glucose uptake by muscles. Benefits of regular exercise include increased sensitivity to insulin, thus allowing a reduced dose, and improved cardiovascular function. An extensive reference list and 14 abstracts on diabetes and exercise are included.

32. Exercise and Diabetic Microangiopathy. D.E. McMillan. Diabetes. [suppl. 1]. 28:103-106; January 1979.

The relation between exercise and microangiopathy in persons with diabetes is discussed. Glucagon and growth hormones favoring the development of angiopathy are elevated during exercise for both those with diabetes and persons not having it. Changes in erythrocytes and capillary walls of persons with diabetes impair oxygen transport, and microangiopathy adversely affects exercise performance in these individuals by decreasing vascular dilation and increasing protein

and water loss from plasma. Moderate exercise and adequate foot protection are recommended for people with diabetes with evident microangiopathy. Difficulties in microvascular testing are noted. (See also Item 30.)

33. Exercise and Insulin: Insulin Binding, Insulin Mobilization, and Counterregulatory Hormone Secretion. V. Koivisto; V. Soman; et al. Federation of American Societies for Experimental Biology; Federation Proceedings. 39(5):1482-1486; April 1980.

Effects of acute exercise and physical training on insulin binding to monocytes are examined in these studies. Special attention is given to insulin mobilization from injection sites and the importance of adequate insulin treatment in determining the hormonal response to exercise. Submaximal exercise substantially increases insulin binding to monocytes in sedentary subjects. Exercise-induced binding in obese subjects is comparatively smaller than in nonobese controls. Insulin binding in well-trained athletes is much higher than in untrained controls; the insulin binding increment correlates with physical fitness. Insulin binding decreases during acute exercise, possibly accounting for athletes' decreased carbohydrate use and greater dependence on fat for energy. Insulin availability is important in regulating plasma glucose and hormone responses of persons with diabetes during exercise. Exercise accelerates insulin absorption from the exercising limb, whereas injection into a non-exercising area does not enhance insulin delivery; this may have implications for the management of insulin-dependent diabetes. Subcutaneous insulin infusion normalizes the plasma growth hormone and catecholamine response to exercise, and the regulatory role of insulin in the metabolic response to exercise involves both substrate utilization and hormonal secretion. (AA-M)

34. Exercise in Diabetes: Therapeutic Implications. V.A. Koivisto; R.S. Sherwin. Postgraduate Medicine. 66(5):87-96; November 1979.

Metabolic responses of subjects with and without diabetes to physical conditioning are reviewed, and exercise-induced hypoglycemia and the effect of insulin on responses to exercise are examined. Exercise by nonketotic, insulin-dependent persons lowers glucose levels, whereas ketotic, insulin-deficient individuals may exhibit increased glucose levels. Since physical conditioning accelerates insulin absorption from the exercising limb, injecting insulin into a non-exercising area can minimize exercise-induced hypoglycemia. Beneficial effects of exercise on carbohydrate and lipid metabolism in normal subjects may also extend to persons with diabetes, provided insulin availability, injection site, and exercise timing are considered. (AA-M)

35. Exercise-Induced Fall of Blood Glucose in Insulin-Treated Diabetics Unrelated to Alteration of Insulin Mobilization. F.W. Kemmer; P. Berchtold; et al. Diabetes. 28:1131-1137; December 1979.

Nine subjects with insulin-dependent diabetes and four nondiabetic subjects were studied during rest and exercise. The purpose was to investigate (1) whether leg exercise accelerates the absorption of exogenous insulin from its subcutaneous depot in persons with insulin-dependent diabetes and (2) whether the glycemic response to exercise in these patients is related to alterations in insulin absorption. The subjects with diabetes received a reduced dose of intermediate-acting insulin and their breakfast in the morning and an injection of regular insulin 1 hour later. Exercise was initiated 35 minutes after the second insulin dose. Regardless of the injection site, there was a pronounced fall of glycemia by 15 percent immediately and by 50 percent 30 minutes after exercise began. Glucose homeostasis was not disturbed by exercise in the nondiabetic subjects. The profound fall in glycemia in the diabetic patients may have been due to the presence of a fixed hyperinsulinemic state rather than to any alteration of insulin mobilization. The results suggest that exercise-induced hypoglycemia in insulin-treated persons is not necessarily prevented by changing the injection site to nonmoving parts of the body. (AA-M)

36. Glucose Turnover During Exercise in Healthy Man and in Patients with Diabetes Mellitus. J. Wahren. Diabetes [suppl. 1]. 28:82-88; January 1979.

The influence of exercise on glucose uptake by contracting muscles and glucose production by the liver is explored. Exercise lowers the blood glucose concentration in insulin-dependent diabetes, thus improving glucose tolerance 24-28 hours beyond the exercise period. Since glucose uptake by muscles and glygogen resynthesis in muscles and probably the liver require a minimal amount of insulin, short-term exercise may intensify diabetes. This underscores the importance of adequate insulin during exercise. (See also Item 30.)

37. Hormone Receptor Interactions. P. Gorden. Diabetes [suppl. 1]. 28: 8-12; January 1979.

Receptors for perturbations of polypeptide hormones and catecholamines occurring in diabetes and exercise are considered. Receptor concentration correlates with insulin level, and receptors binding hormones can be affected by a high hormone concentration. Thus, hyperinsulinemia in obesity can inhibit insulin binding; reduced caloric intake can increase binding and reduce hyperinsulinemia. Competition for insulin at binding sites is discussed. (See also Item 30.)

38. Increased Insulin Receptors After Exercise in Patients With Insulin-Dependent Diabetes Mellitus. O. Pedersen; H. Beck-Nielsen; L. Heding. New England Journal of Medicine. 302(16):886-891; 17 April 1980.

Insulin binding to erythrocytes and monocytes was determined in athletically untrained young men with insulin-dependent diabetes during 3 hours of postprandial bicycle exercise and 2 hours of exercise while fasting. Compared with control periods, both postprandial exercise and exercise while fasting signficantly increased insulin binding at an insulin-tracer concentration of 34 pmol per liter. It is suggested that similar changes occur in working muscle cells, contributing to the improved glucose tolerance induced by exercise. (AA-M)

39. Influence of Insulin and Contractile Activity on Muscle Size and Protein Balance. A.L. Goldberg. Diabetes [suppl. 1]. 28:18-24; January 1979.

The biochemical mechanism by which insulin and contractile activity affect protein turnover in muscles is described. Increased work or contractile activity can induce muscle hypertrophy and, like insulin, can stimulate the transport of amino acids to muscles and reduce protein degradation in tissues. Insulin, however, selectively influences degradation and stimulates protein synthesis as well. The selectivity of protein degradation by liver and muscles is lost in starved and diabetic states. (See also Item 30.)

40. Metabolism of Free Fatty Acids and Ketone Bodies During Exercise in Normal and Diabetic Man. L. Hagenfeldt. Diabetes [suppl. 1]. 28: 66-70; January 1979.

The transport of free fatty acids (FFA) and ketones during exercise is investigated. With brief heavy exercise, FFA levels are low and muscle glycogen is used for energy production. During low-intensity and prolonged exercise, increased production and preferential use of FFA are important in glucose regulation. The fractional turnover of FFA is similar in persons with diabetes and control subjects, but exercise when hyperketonemia is present accelerates FFA turnover and ketone body production, and muscles may not compensate for the overload. (See also Item 30.)

41. Muscle Fiber Characteristics in Healthy Men and in Patients with Juvenile Diabetes. B. Saltin; M. Houston; et al. Diabetes [suppl. 1]. 28:93-99; January 1979.

Eight men with insulin-dependent diabetes were compared to a control group in terms of muscle characteristics and capacity during exercise. Muscle fiber type and glycogen content were similar for those

with diabetes and control subjects. Capillary supply in persons with diabetes was somewhat low, suggesting the limited potential for aerobic energy production. (See also Item 30.)

42. Pharmacokinetics of Subcutaneously Injected Tritiated Insulin: Effects of Exercise. M. Berger; P.A. Halban; et al. Diabetes [suppl. 1]. 28:53-57; January 1979.

The effect of exercise on exogenous insulin absorption by the circulatory system was studied. In experiments with normal rats, exercise caused insulin to accumulate in skeletal muscles. Exercise increased the circulating insulin of two patients with insulin-dependent diabetes, possibly explaining the occurrence of exercise-induced hypoglycemia after insulin injection. Further research on the pharmacokinetics of diabetes management is recommended. (See also Item 30.)

43. Physical Education and Recreation for Impaired, Disabled, and Handicapped Individuals: Past, Present, Future. [anon.]. Washington, DC: American Alliance for Health, Physical Education, and Dance; 1975. 432 p.

The book comprises a systematic collection, analysis and synthesis of research data, program information, and various resource materials in recreation/therapeutic recreation and physical education for disabled individuals. Each of the more than 20 state-of-the-art reports includes a review of available literature, summaries of priority needs in research and demonstration, personnel preparation, and media needs.

Price: $11.95.

Source: American Alliance for Health, Physical Education, and Dance; 1201 16th St., NW; Washington, DC 20036. (202) 833-5541.

44. Physical Exercise and Fuel Homeostasis in Diabetes Mellitus. J. Wahren; P. Felig; L. Hagenfeldt. Diabetologia. 14:213-22; 1978.

Recent findings are presented on fuel utilization patterns and fuel production for persons with diabetes and nondiabetic persons during exercise. Carbohydrate and fat contributions to the oxidative metabolism of working muscle as well as the rates of hepatic gluconeogenesis and ketogenesis are discussed. The importance of adequate insulin dosage in conjunction with exercise is stressed. The metabolic effects of exercise are largely determined by the time interval between insulin administration and exercise. Postexercise glycogen resynthesis, which prolongs glucose utilization in liver and muscle tissues, may account for many of the benefits.

45. Physical Training and Glucose Tolerance in Middle-Aged Men with Chemical Diabetes. B. Saltin; F. Lindgarde; et al. Diabetes [suppl. 1]. 28:30-32; January 1979.

The role of exercise in middle-aged men's glucose tolerance was studied. In therapeutic trials that included dietary advice and/or physical training, data were obtained on 100 normoglycemic men (ages 47-49) with impaired glucose tolerance (IGT) and on age-matched controls. The subjects with IGT exhibited low work capacity and low oxidative enzyme levels in skeletal muscles but were not more overweight than the controls. Although the beneficial effect of exercise, as opposed to a change in diet, could not be clearly established in the study, improvements in glucose tolerance were noted in the subjects with IGT. (See also Item 30.)

46. The Role of Insulin in the Metabolic Response to Exercise in Diabetic Man. B. Zinman; M. Vranic; et al. Diabetes [suppl. 1]. 28:76-81; January 1979.

The role of insulin in mediating metabolic responses to moderate bicycle exercise was determined by comparing different insulin administration routes for overnight-fasting persons with diabetes and matched controls. Insulin mediated responses in three phases: uptake of glucose by the exercising muscle; hepatic production of glucose; and peripheral release of energy substrates. Insulin infusion produced relatively normal responses, while the subcutaneous injection route was affected by the proximity of the site to the exercised muscle. (See also Item 30.)

47. Successful Diet and Exercise Therapy Is Conducted in Vermont for "Diabesity." R.S. Gordon. Journal of the American Medical Association. 243(6):519-120; 8 February 1980.

Findings are presented from a continuing series of studies of the association between adult obesity and noninsulin-dependent diabetes. Results indicate that overweight patients in the early stages of Type II diabetes may more properly be treated by controlled diet and exercise than by insulin treatments because the pancreas may produce an increased amount of insulin in the disease's early stages. Without diet restrictions, however, this increased amount of insulin may not be enough to counteract increased insulin resistance.

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